

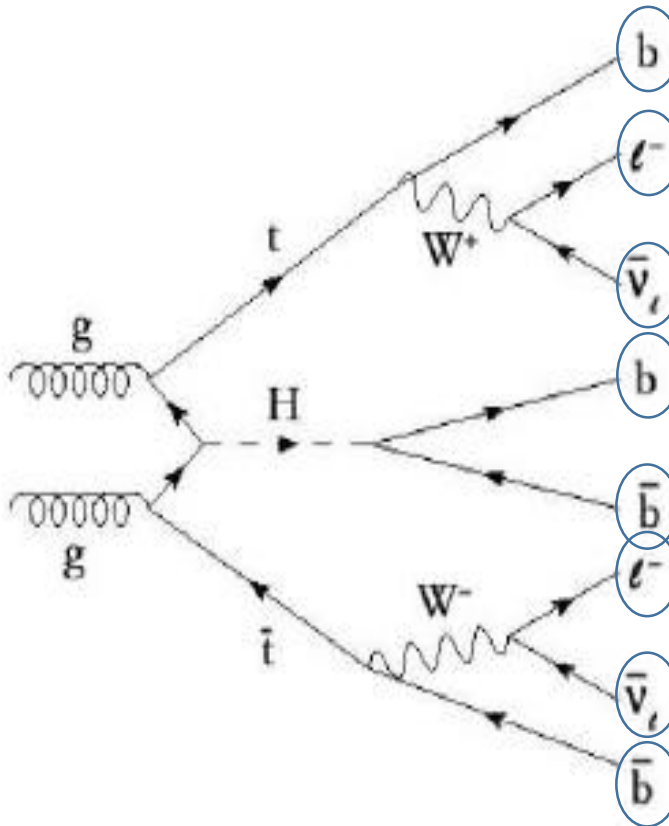
A 3D visualization of the ATLAS detector, showing the complex structure of the particle detector with various components in shades of blue, green, and yellow. A central particle collision event is depicted as a bright yellow starburst with numerous lines radiating outwards, representing the tracks of particles produced in the collision.

# Study of the Higgs couplings to top quarks in ATLAS

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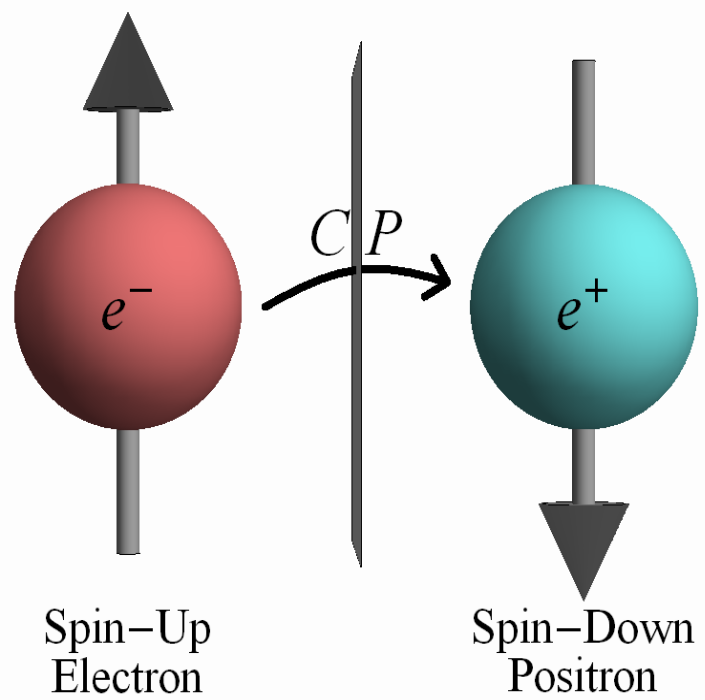
# Objectives

- Verify the possibility of the linear interpolation between CP – even and CP –odd for dileptonic ttH



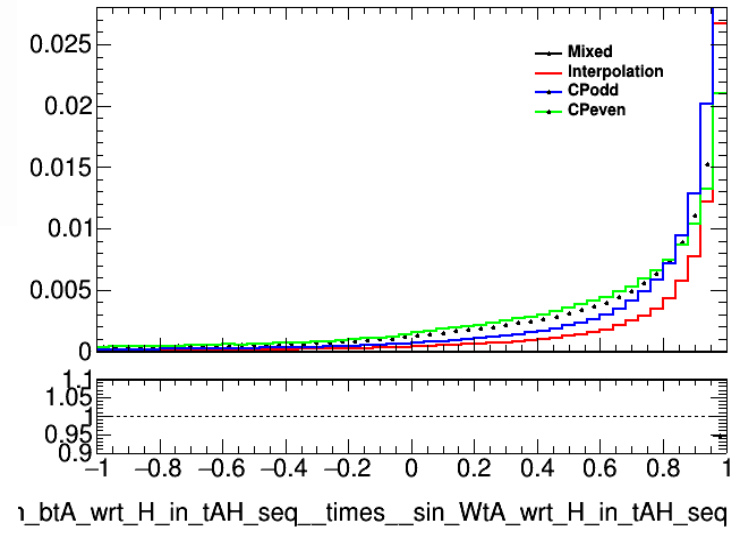
**Final State objects**  
-4 b quarks  
-4 leptons – 2  
electrons or muons  
and 2 respective  
neutrinos

# Linear Interpolation

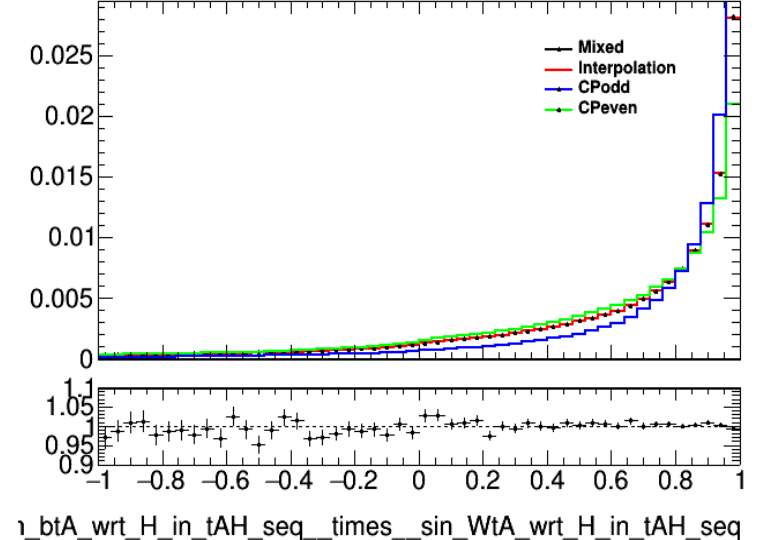


$$\cos^2\alpha \cdot \text{CP even} + \sin^2\alpha \cdot \text{CP odd} = \text{CP mixed}$$

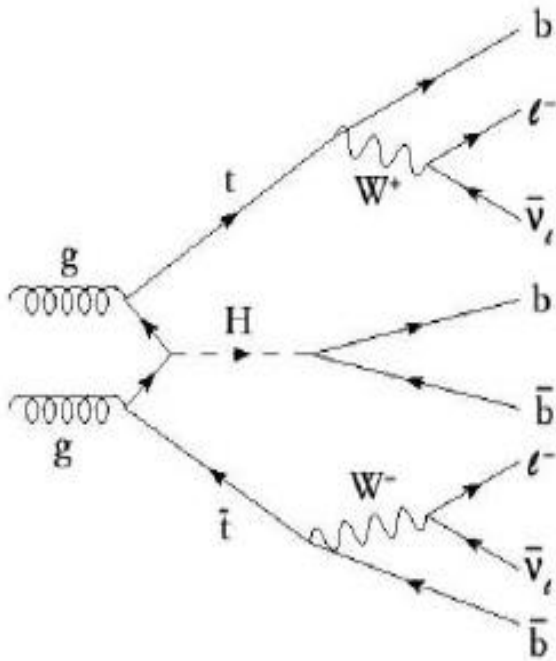
$$\mathcal{L} = \kappa y_t \bar{t} (\cos \alpha + i\gamma_5 \sin \alpha) t h$$



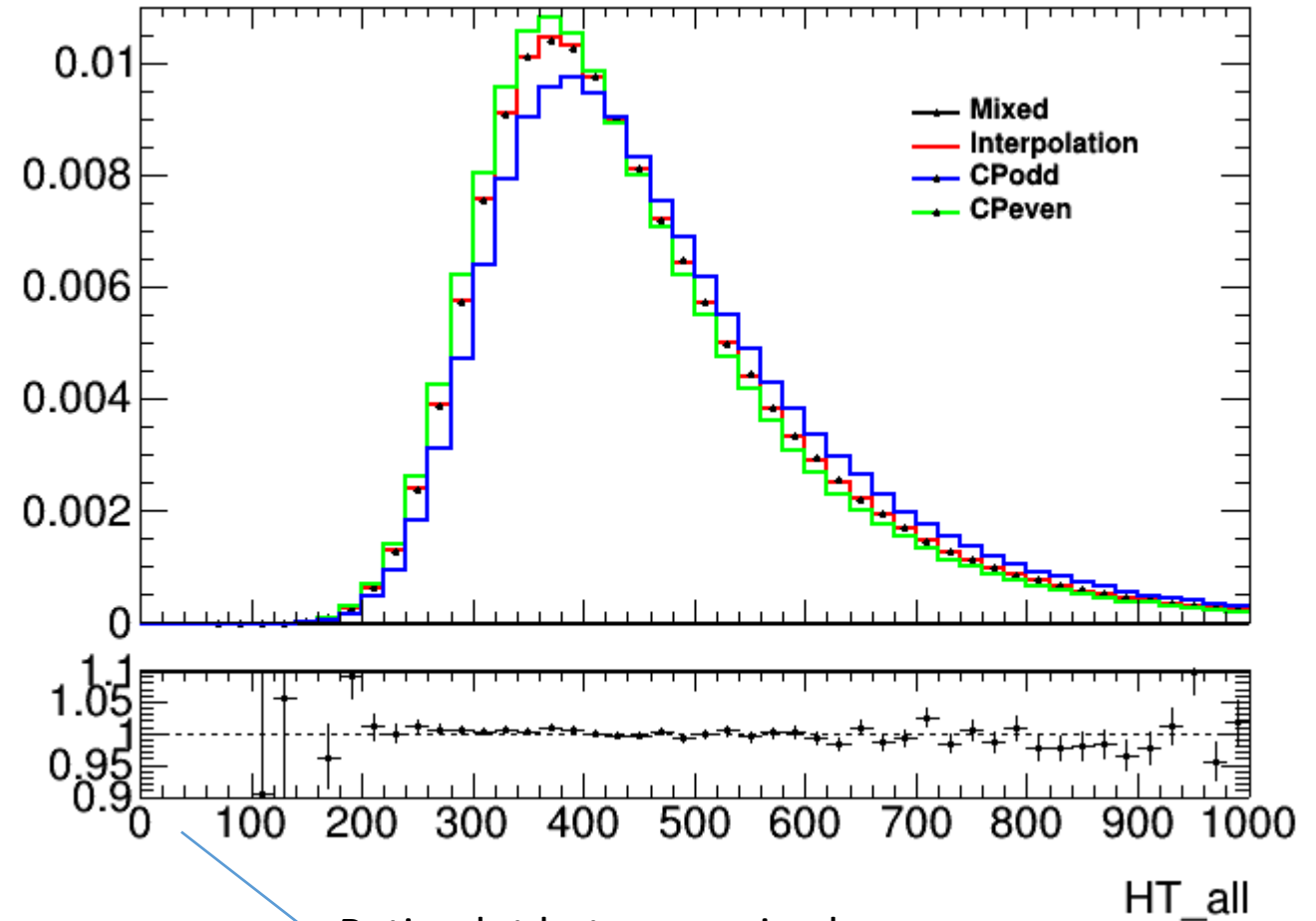
$\alpha=45^\circ$



# HT\_all - Scalar sum of the pT of all final state objects

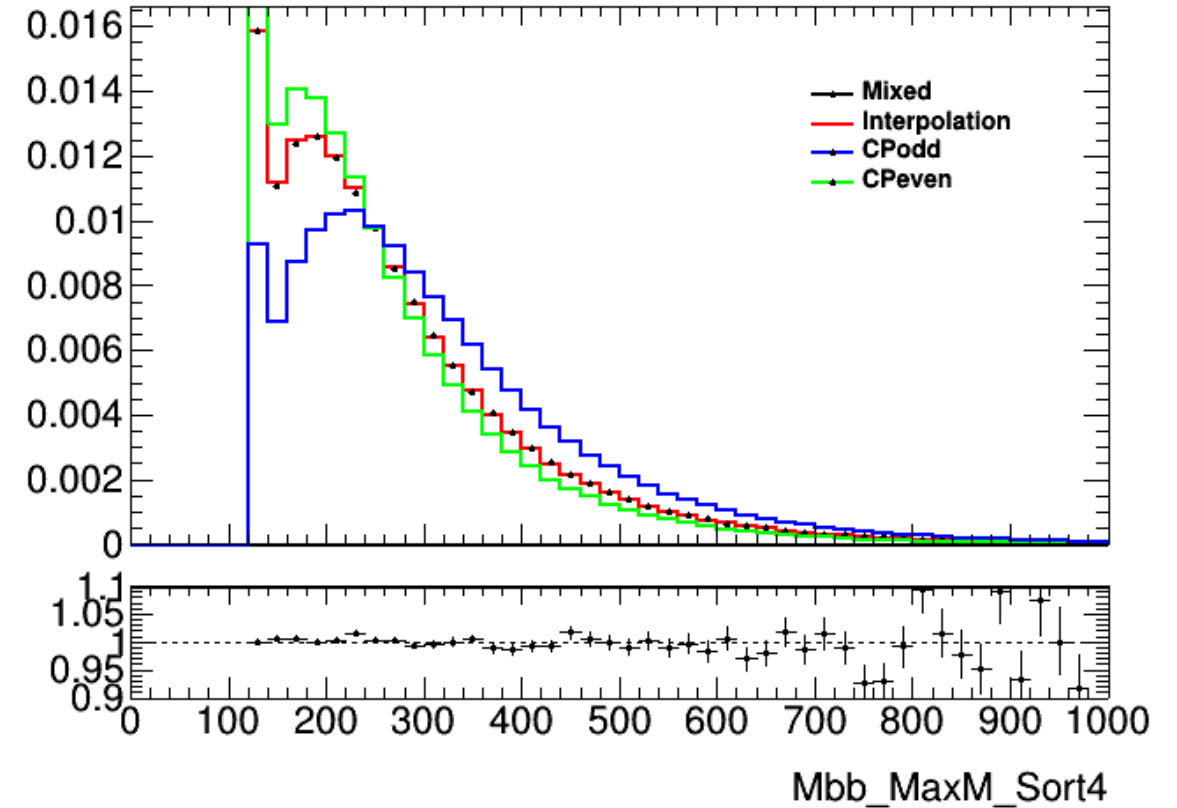


- 2 leptons (the other 2 are MET)
- 4 b quarks

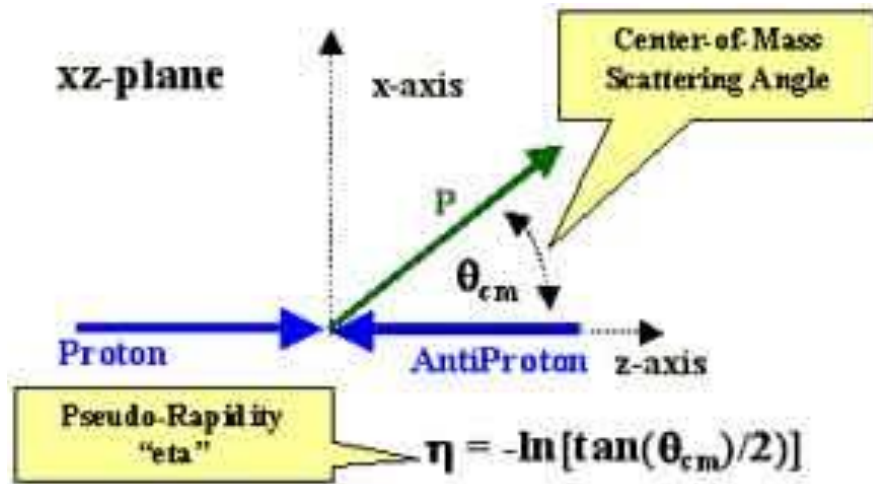


# Mbb\_MaxM\_Sort4 - Choose pairing that maximizes invariant mass

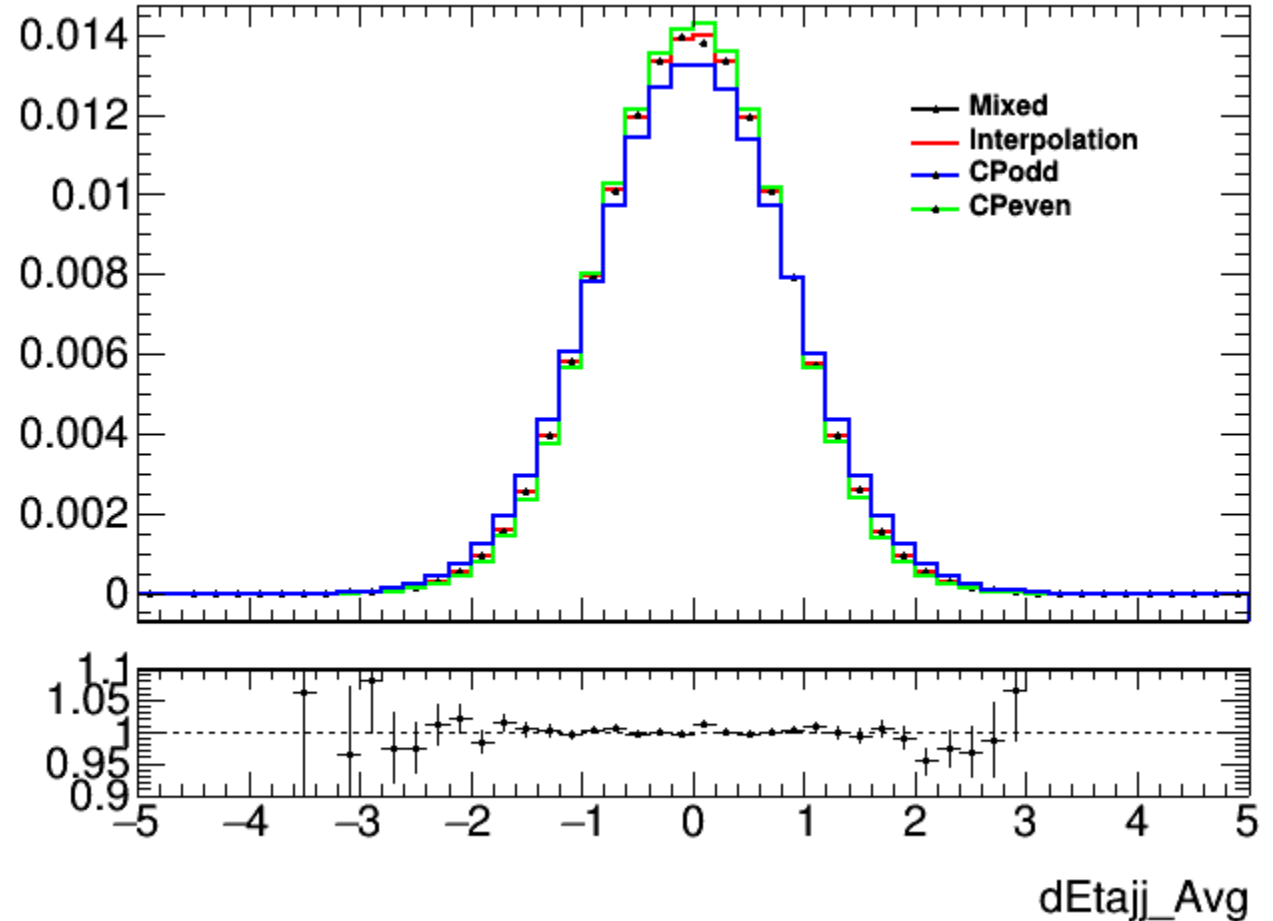
- Choose the pair of B quarks that maximizes the invariant mass
- Mass of the Higgs = 125 GeV – high in the histogram



# dEta<sub>j</sub>\_Avg - average delta Eta between all jet pairs including b jets

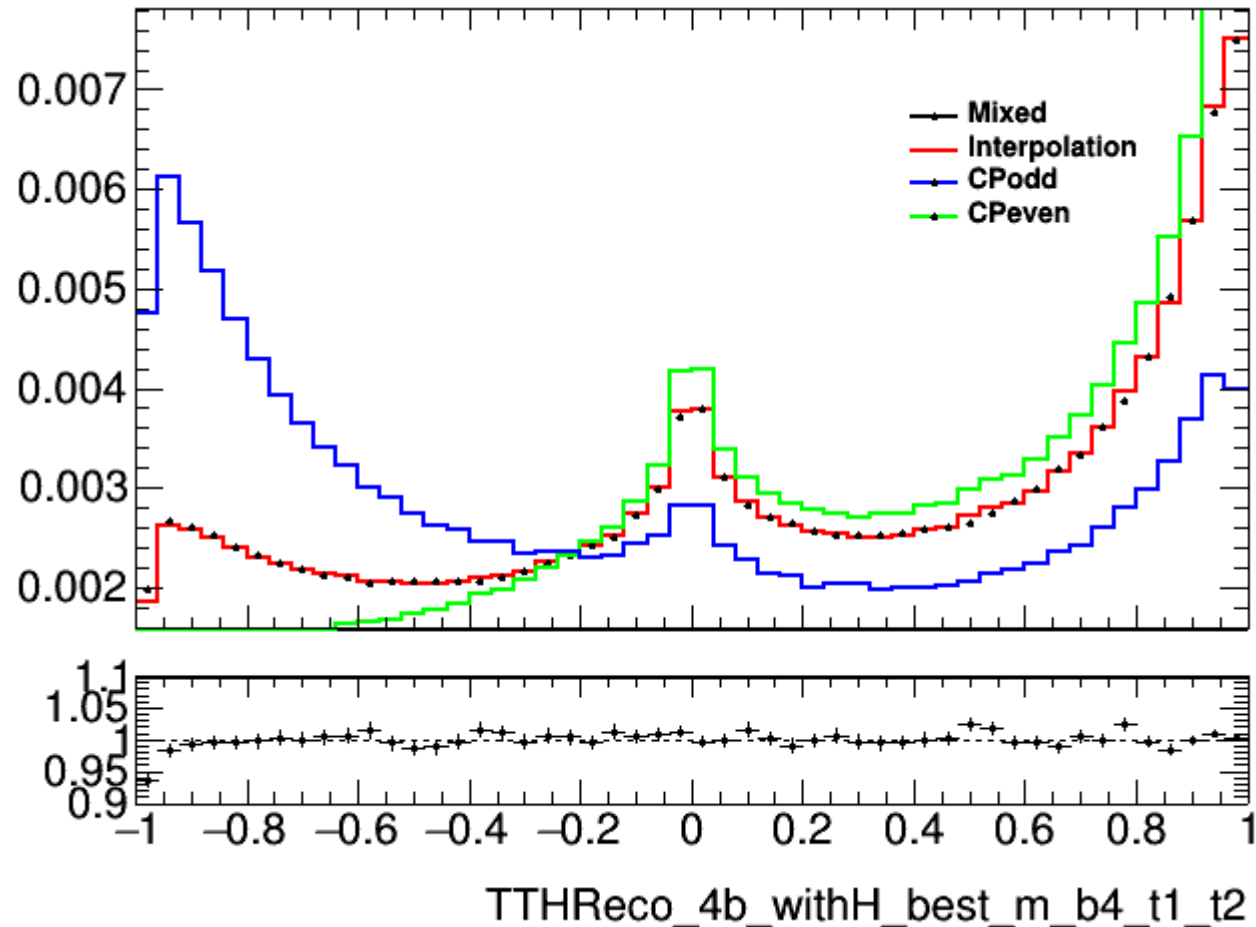


$$\Delta\eta_{Avg} = \frac{\sum \Delta\eta(b_1, \dots, b_4)}{C_{4,2}}$$

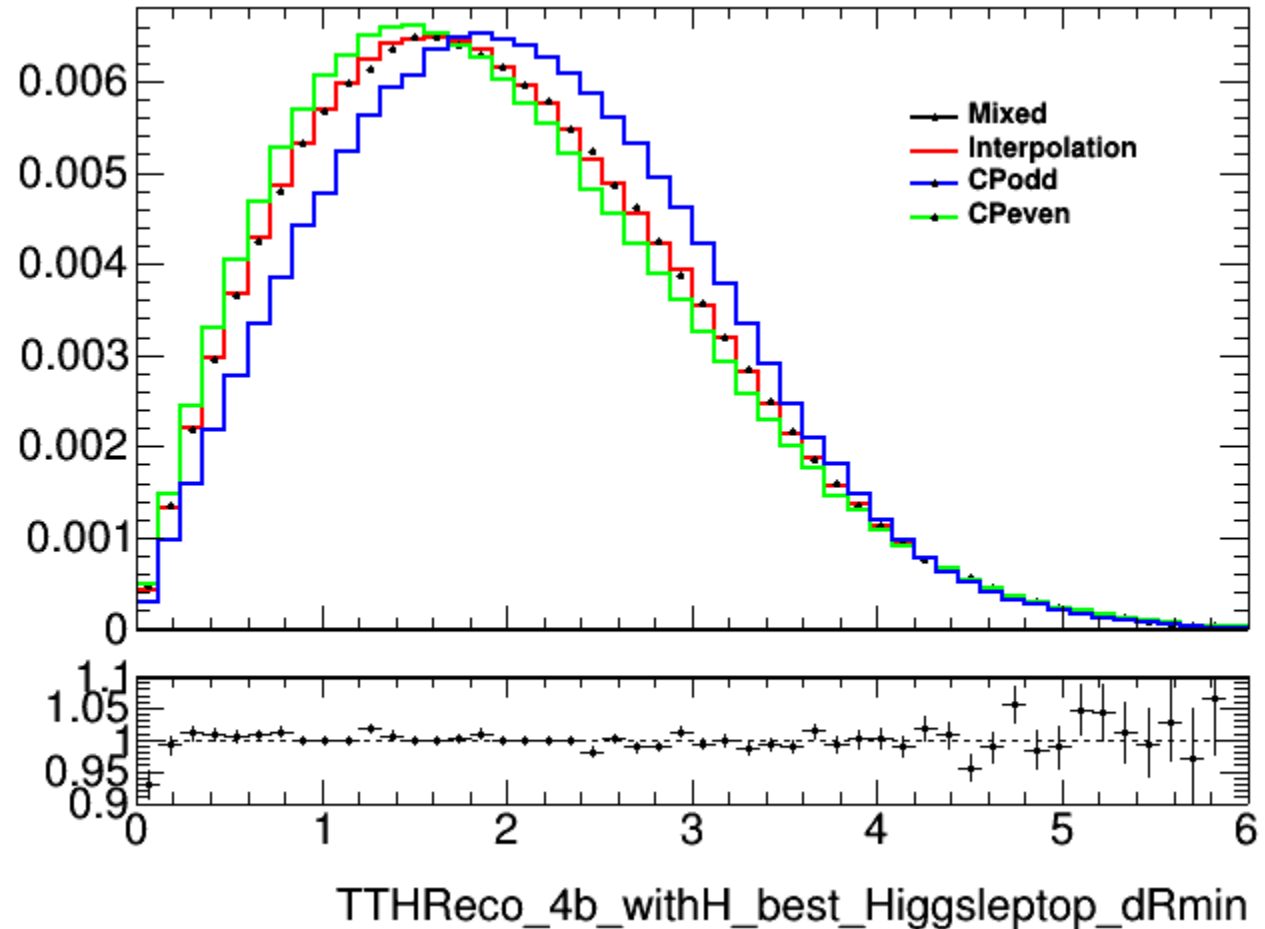
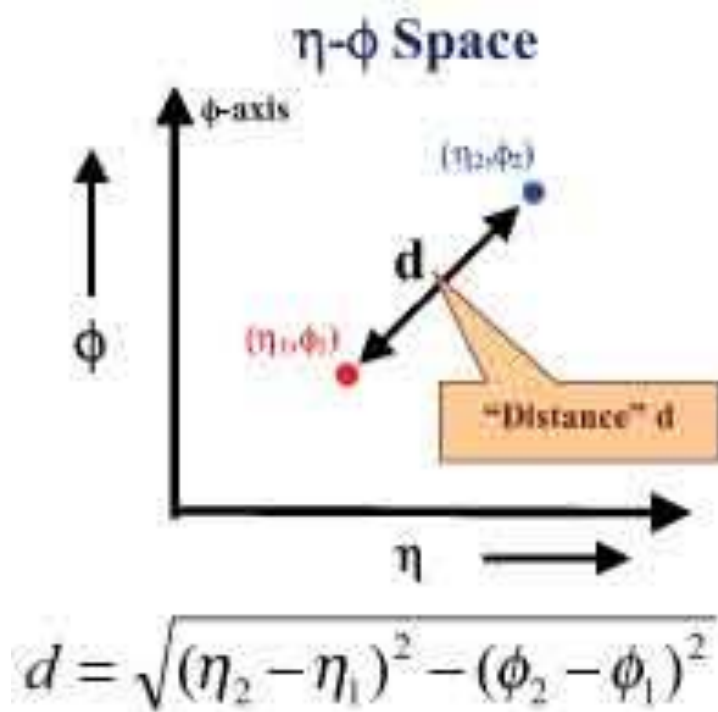


# TTHReco\_4b\_withH\_best\_m\_b4\_t1\_t2 - b4 variable computed for the top and anti top

$$\frac{\rho_z(t_1) \cdot \rho_z(t_2)}{\rho(t_1) \cdot \rho(t_2)}$$

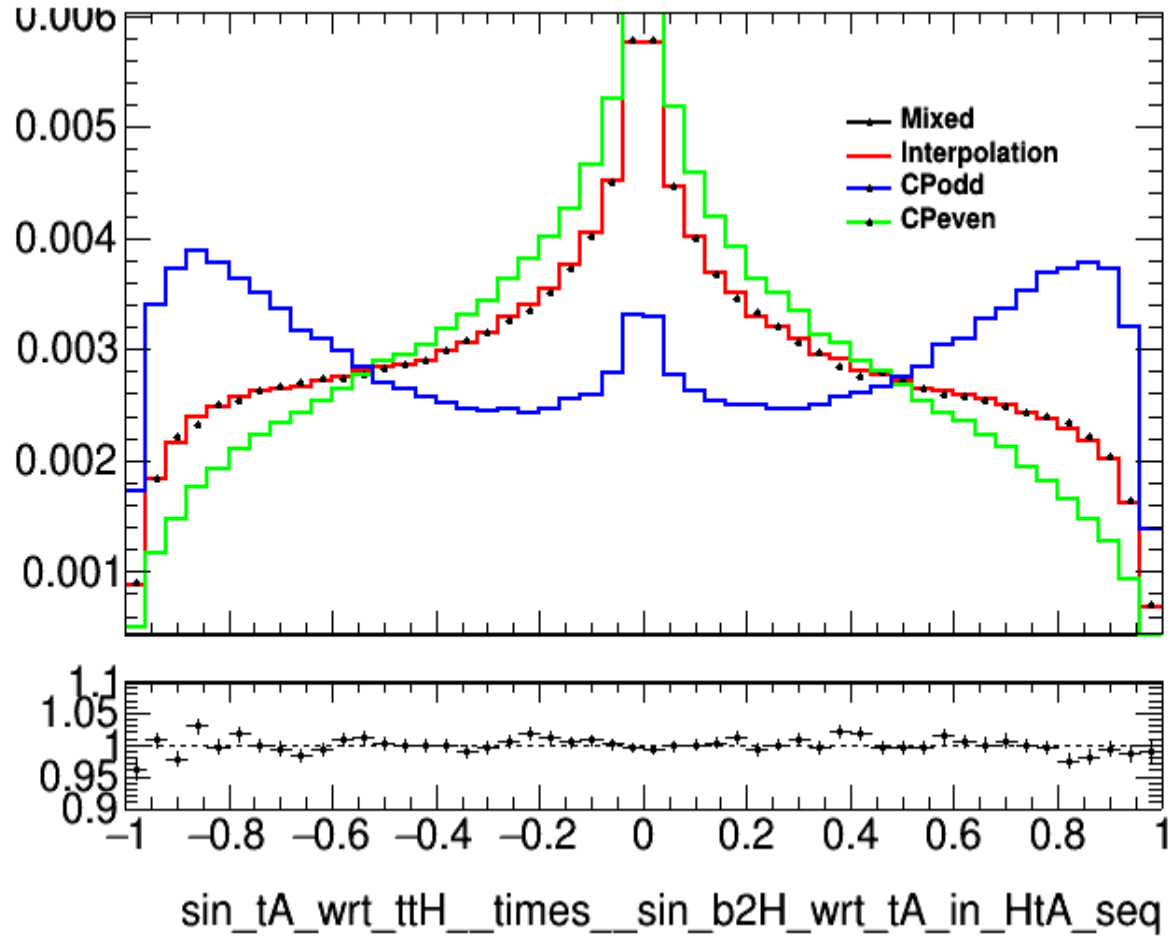


# TTHReco\_4b\_withH\_best\_Higgslepton\_dRmin - dRmin between lep and Higgs

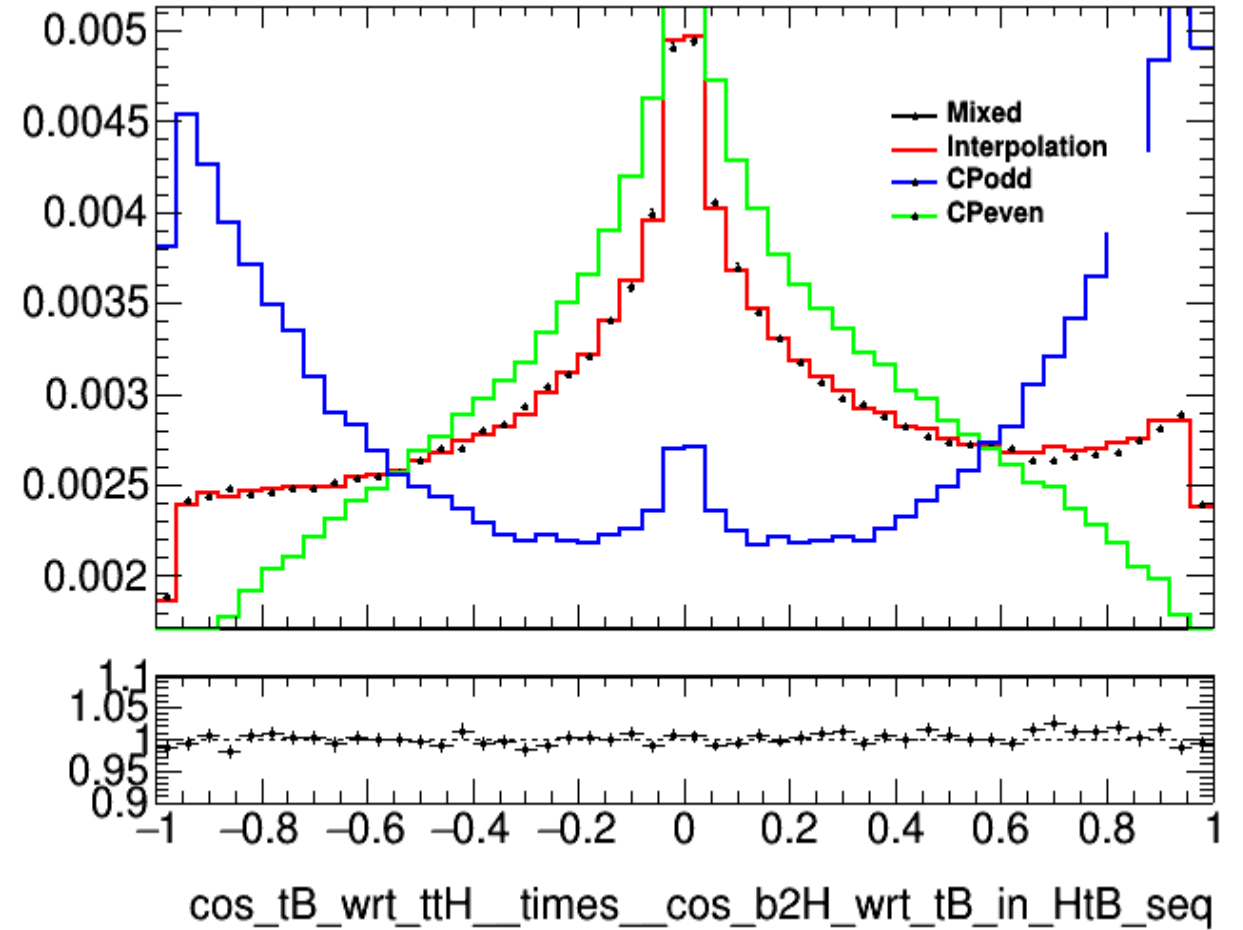




sin\_tA\_wrt\_ttH\_times\_sin\_b2H\_wrt\_tA\_in\_HtA\_seq



cos\_tB\_wrt\_ttH\_times\_cos\_b2H\_wrt\_tB\_in\_HtB\_seq



# Conclusions

- We verified the linear interpolation between CP even and CP odd for the dileptonic  $t\bar{t}H$ .
- This can serve as a template for future studies.
- Future Steps:
  - Try different values of  $\alpha$  and different mixed samples
  - Use other variables with high sensitivity to the nature of CP